DSN and GAVRT Observations of Jupiter at 13 GHz and the Calibration of the Cassini Radar Instrument for Passive Radiometry

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The flyby of the Cassini-Huygens spacecraft past Jupiter in December 2000 provided an opportunity to perform in-flight calibrations of the passive microwave radiometer subsystem that is part of the Radar Instrument on the spacecraft. The objectives of the Radar Instrument are to map the surface of Titan and to measure properties of Saturn's rings and atmosphere. The in-flight calibrations (see companion paper by Janssen et al.) were supported by a coordinated series of ground-based observations named the Cassini–Jupiter Microwave Observing Campaign (Cassini-JMOC). One objective of the Cassini-JMOC program was to support the in-flight calibrations by measuring the flux density of Jupiter at 13.78 GHz with a 1-sigma accuracy of two percent. A second objective of the project included an educational component that allowed middle- and high school students to participate directly in the ground-based observations and data analysis.

This paper reports the Cassini-JMOC observations supported by NASA's Deep Space Network (DSN) antennas at Goldstone, California. The observations were made from November 2000 through March 2001 using two 34-m diameter antennas. Precision measurements of Jupiter's flux density relative to Venus and to a selection of radio sources were made in order to derive an accurate flux density for Jupiter at the spacecraft frequency (13.780 GHz). A variety of calibration radio sources were selected in order to minimize systematic errors being introduced because of the nature of the calibration sources themselves. To randomize the calibration sources, we chose sources with different spectral indices, source solid angles, polarization, position on the sky, and hour angle. Special observations using a "raster scan" technique were made to map the brightness distribution of radio sources with solid angles that are partially resolved by the antenna beam. Using the maps, the total flux densities of 3C405, 3C274, Jupiter and Venus were accurately derived from the observed flux densities.

A large percentage of the Goldstone observations were conducted by middle- and high school students from classrooms across the nation. The students and their teachers are participants in the Goldstone-Apple Valley Radio Telescope (GAVRT) science education project, which is a partnership involving NASA, the Jet Propulsion Laboratory and the Lewis Center for Educational Research (LCER) in Apple Valley, CA. Working with the Lewis Center over the Internet, GAVRT students conduct remotely controlled radio astronomy observations using 34-m antennas at Goldstone.

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